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# INSTRUCTION MANUAL

(14)

# The Mega-Pulser

KAY ELECTRIC COMPANY

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# INSTRUCTION BOOK

for the

# MEGA-PULSER


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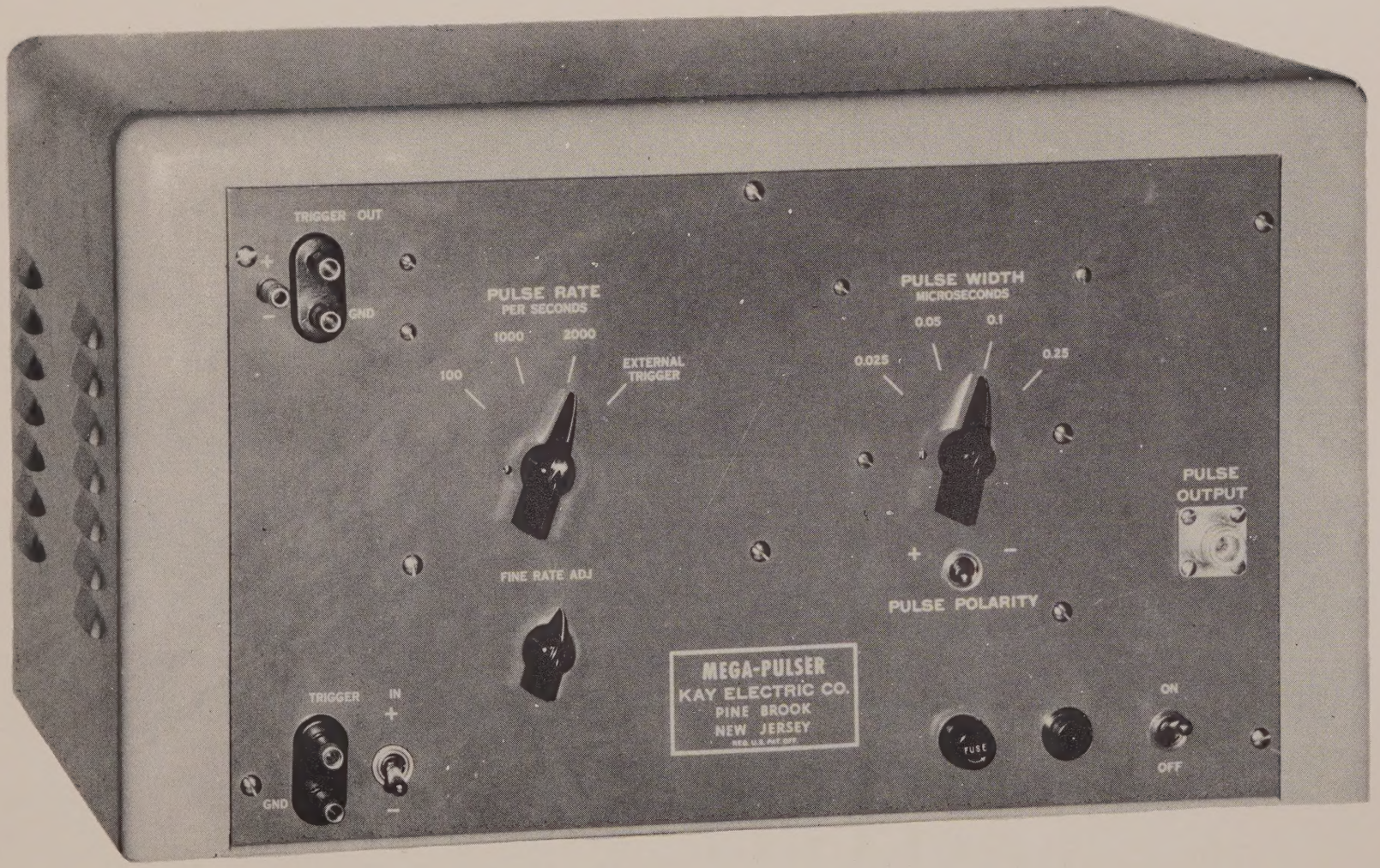



THE MEGA-PULSER

1.

## SECTION I FUNCTION

The function of the MEGA-PULSER is to produce pulses of 0.025, 0.05, 0.1 and 0.25 microseconds duration, having an amplitude of plus or minus 100 volts at repetition rates of 100, 1000 and 2000 pps. For use with external equipment the MEGA-PULSER also generates simultaneously positive and negative synchronizing pulses. The MEGA-PULSER can also be triggered by an external generator of pulses of either polarity. The trigger pulses, whether from internal or external source, precede the output pulse by a time interval of 0.25 microseconds. This feature is of particular value because it makes it possible to start an associated oscilloscope sweep before the MEGA-PULSER output pulse so that the circuit response can be studied without losing the leading edge of the response wave form.

## SECTION II OPERATION

Operation of the MEGA-PULSER as a test signal source for pulse response study is quite straightforward. The manner of adjustment of all dials is evident from the labeling. If it is desired to have the MEGA-PULSER furnish pulses and synchronizing pulses at a repetition rate of 1000 pps, the PULSE RATE switch should be set to 1000. (By adjustment of the FINE RATE ADJ. it is possible to vary the repetition rate slightly and thus avoid undesirable synchronization with other apparatus). If it is desired to trigger the MEGA-PULSER from an external pulse generator, the PULSE RATE switch should be set to EXTERNAL TRIGGER and the toggle switch adjacent to the TRIGGER IN jack should be thrown up for positive trigger pulses and down for negative trigger pulses. The MEGA-PULSER will trigger satisfactorily from ($\pm$) pulse of approximately 20 volts.

The TRIGGER OUT jacks furnish low impedance positive and negative synchronizing pulses of approximately 50 volts amplitude for use in triggering auxiliary equipment. It should be noted that low impedance terminations on these jacks will somewhat influence the repetition rate of the MEGA-PULSER.

The PULSE OUTPUT coaxial jack furnishes a ($\pm$) 100 volt pulse across a 50 ohm load. It is important that any cable which is connected to the MEGA-PULSER should be properly terminated. If this is not done, multiple reflections will cause pulse distortions. The polarity of the output pulses is controlled by the PULSE POLARITY switch on the panel.

## SECTION III APPLICATIONS

The amplitude of the PULSE OUTPUT is such as to allow observation without amplification by connecting directly to the plates of a cathode ray tube. This is important in that it makes it possible to avoid the use of the elements, such as amplifiers, which are most likely to cause distortion. Thus, if it is desired to know the rise time of a video amplifier, first the full pulse amplitude of the MEGA-PULSER is placed across the plate and a reference wave form obtained. Then the output of the MEGA-PULSER is attenuated by suitable coaxial pads placed between the MEGA-PULSER and the video amplifier. The output of the video amplifier is then placed across the plate and the pulse distortion contributed by the video amplifier can be evaluated.

The pulses furnished by the MEGA-PULSER contain high frequency components which require careful attention to lead lengths and proper terminations. Thus the leads to the plate of the cathode ray tube should be very short. Best results are obtained when a coaxial cable is used and a 50 ohm terminating resistor placed right

at the plate of a 5JP1 or 5RP1 type of tube. These tubes have very short leads right through the tube neck to the plates. It is also necessary to employ care to see that cross-talk between vertical and horizontal plates if kept small. Cross-talk can be identified by the doubling back of the leading edge of the pulse under display. Cathode ray tubes which have the plate connections brought down to the base are sometimes difficult to use because of the cross-talk which results from the long plate leads inside of the tube. It will usually be found that the pulse type of oscilloscope is necessary to obtain displays which are completely satisfactory. A triggered sweep with start-stop features will give the best results. It is difficult to maintain the position of the leading edge of the pulse from the MEGA-PULSER with enough accuracy to allow the use of synchronized sweeps.

## SECTION IV CIRCUIT DESCRIPTION

The MEGA-PULSER consists of a three tube pulsing circuit mounted on the front panel and an auxiliary power supply chassis containing two rectifier tubes and suitable filter circuits. The delay lines, made up of four lengths of coaxial cable, are mounted above the power supply.

The pulsing circuit uses two type 6SN7GT twin triodes and a single 2D21 gas tetrode. Reference should be made to the schematic diagram included in this book. The two twin triodes act as four separate tubes with the following functions:

1) V1A acts as a phase inverter for external negative trigger signals.

2) V1B acts as an isolation amplifier for the trigger pulses to the blocking oscillator V2B.

3) V2A is connected in parallel with V2B.

4) V2B is a blocking oscillator which furnishes the low impedance pulse for firing the gas tube and triggering the associated equipment which may be connected to the TRIGGER OUT jacks.

The delay network made up of C4 and L1 delays the trigger pulse applied to V3 by approximately 0.25 microseconds. The gas tube (V3) is thus fired after a delay which allows sufficient time for the starting of sweep circuits in any associated oscilloscope.

A 2D21 gas tube, V3, acts as the desired low impedance switch which forms the short pulses. The pulses are generated by the discharge of this tube into a delay line with its far end open-circuited. The pulse width is varied by the selection of the proper length open-circuited delay line. A four-position rotary switch offers the choice of 0.025, 0.05, 0.10 and 0.25 microsecond pulses. The pulse width is related to: the length of cable, the speed of propagation in this cable and the parameter of compensating networks (C6, C7, C8, C9 and R25).

The use of a gas tube makes possible the low impedance switching which is necessary for the short pulse generation which is desired. But gas tubes have a limitation which should be noted. The repetition rate should ordinarily not exceed 2000 pps. However, with the shorter pulses and EXTERNAL TRIGGER it is sometimes possible to raise the repetition rate to as high as 5000 pps. These repetition rates are high enough to give a bright display on a good pulse oscilloscope.

The polarity of the output pulse is determined by the position of a double pole double throw switch in the cathods of the switching gas tube V3. For positive output pulses the switch is thrown to a position which places the load resistor, R23,

across which the output is developed, into the cathode of V3. In this position the shields of the coaxial delay cables numbers 1, 2, 3 and 4 are returned to ground. When tube V3 is fired, positive voltage appears across R23, in a very short period of time, and is maintained until the reflection from the end of the delay cable de-energizes V3, compelling R23 to return to ground potential. For obtaining a negative pulse, the switch is thrown in the opposite direction, grounding the cathode of V3 and placing the output load resistance (R23) between the shields of the delay cables 1, 2, 3 and 4 and ground. Firing the gas tube in this condition lowers the potential across the center conductor of the delay cable from +300 to a very low potential. One-half of this drop appears across the delay cable and the remainder across R23. This condition is maintained until a reflection returns from the open end of the delay cable. This drop in voltage extinguishes the gas tube (V3) and removes the potential from R23.

The tubes V4 and V5, shown on the schematic attached to this book, are respectively the rectifiers which, in conjunction with the accessory equipment shown, develop the 300 volts positive and negative necessary for operation of the equipment.

## SECTION V SPECIAL APPLICATIONS

In addition to the more common uses of the MEGA-PULSER as a source of test signals for video amplifier study, another important application should be noted. By combining the MEGA-PULSER with the MEGA-SWEEP it is possible to obtain a source of pulsed carrier signals that will include most of the useful r.f. spectrum. Thus by pulsing the MEGA-SWEEP, pulsed carriers from a few megacycles up to 1000 megacycles are available. This combination of MEGA-PULSER and MEGA-SWEEP makes possible the transient response study of wide band i.f. and r.f. amplifiers of practically all common frequencies.

A useful relationship between the rise time and band width for such amplifiers is given in the July 1948 issue of PROCEEDINGS of the I.R.E. on page 871, "Time Response of an AMPLIFIER of N Identical Stages", by Eugene F. Grant.

$$t = \frac{0.7}{\Delta fn}$$

where: $\Delta fn$ is the 3 db. band width

$t$ is the time to rise from 0.1 to 0.9 the final value.

The above relationship is for single-tuned amplifiers of a large number of stages.

# PARTS LIST

## MEGA-PULSER

### TUBES:

| | | | |
|---|---|---|---|
| V-1 | 6SN7GT | V-4 | 5Y3GT |
| V-2 | 6SN7GT | V-5 | 6X5GT |
| V-3 | 2D21 | | |

### RESISTORS: (All resistors are 1/2W unless otherwise specified)

| | | | |
|---|---|---|---|
| R-1 | 1 meg. | R-18 | 220 K. - 1W |
| R-2 | 470 ohms | R-19 | 33 K. |
| R-3 | 4.7 K | R-20 | 150 K. |
| R-4 | 12K - 1W | R-21 | 470 K. |
| R-5 | 1 meg. | R-22 | 3.3 K. |
| R-6 | 100 K. | R-23 | 51 ohms |
| R-7 | 100 ohms | R-24 | 270 K. |
| R-8 | 100 ohms | R-25 | 22 ohms |
| R-9 | 150 ohms | R-26 | 270 K. |
| R-10 | 150 ohms | R-27 | 500 ohms - 5W |
| R-11 | 3.3 K. | R-28 | 4.7 K. - 1W |
| R-12 | 2.2 meg. | R-29 | 47 K. - 1W |
| R-13 | 220 ohms | R-30 | 2.2 meg. |
| R-14 | 8.2 meg. | R-31 | 4.7 K. - 2W |
| R-15 | 470 K. | R-32 | 220 K. - 1W |
| R-16 | 470 K. | R-33 | 4.7 K. - 2W |
| R-17 | 180 K. | R-34 | 100 K. - Fine Rate Adj. |

### CONDENSERS:

| | |
|---|---|
| C-1 | .01 mf. Mica or Ceramic 500V |
| C-2 | .01 mf. " " " |
| C-3 | .01 mf. " " " |
| C-4 | 82 mmf. " " " |
| C-5 | 3300 mmf. " " " |
| C-6 | 140 mmf. " " " |
| C-7 | 140 mmf. " " " |
| C-8 | 240 mmf. " " " |
| C-9 | 240 mmf. " " " |
| C-10 | 20 x 20 mf. Electrolytic 450V |
| C-11 | 1.0 mf. Paper oil filled 600V |
| C-12 | 1.0 mf. " " " " |
| C-13 | .01 mf. Mica or Ceramic 500V |

### TRANSFORMERS:

| | |
|---|---|
| T-1 | Industrial KP51 - Power |
| T-2 | Utah #9280 - Special |

# PARTS LIST

## MEGA-PULSER

### SWITCHES:

| | |
|---|---|
| S-1 | S. P. S. T. - ON-OFF; Power Line |
| S-2 | Special - Repetition Rate |
| S-3 | D. P. D. T. - Pulse Polarity |
| S-4A | Special - Pulse Width) Ganged |
| S-4B | " " " ) |
| S-5 | S. P. S. T. - Trigger Input |

### JACKS:

| | |
|---|---|
| J-1 | General Radio Type - Trig. Output |
| J-2 | " " " Input |
| J-3 | UG 58/U - Pulse Output |

### COILS:

| | |
|---|---|
| L-1 | 50 mh Choke |

### CABLES:

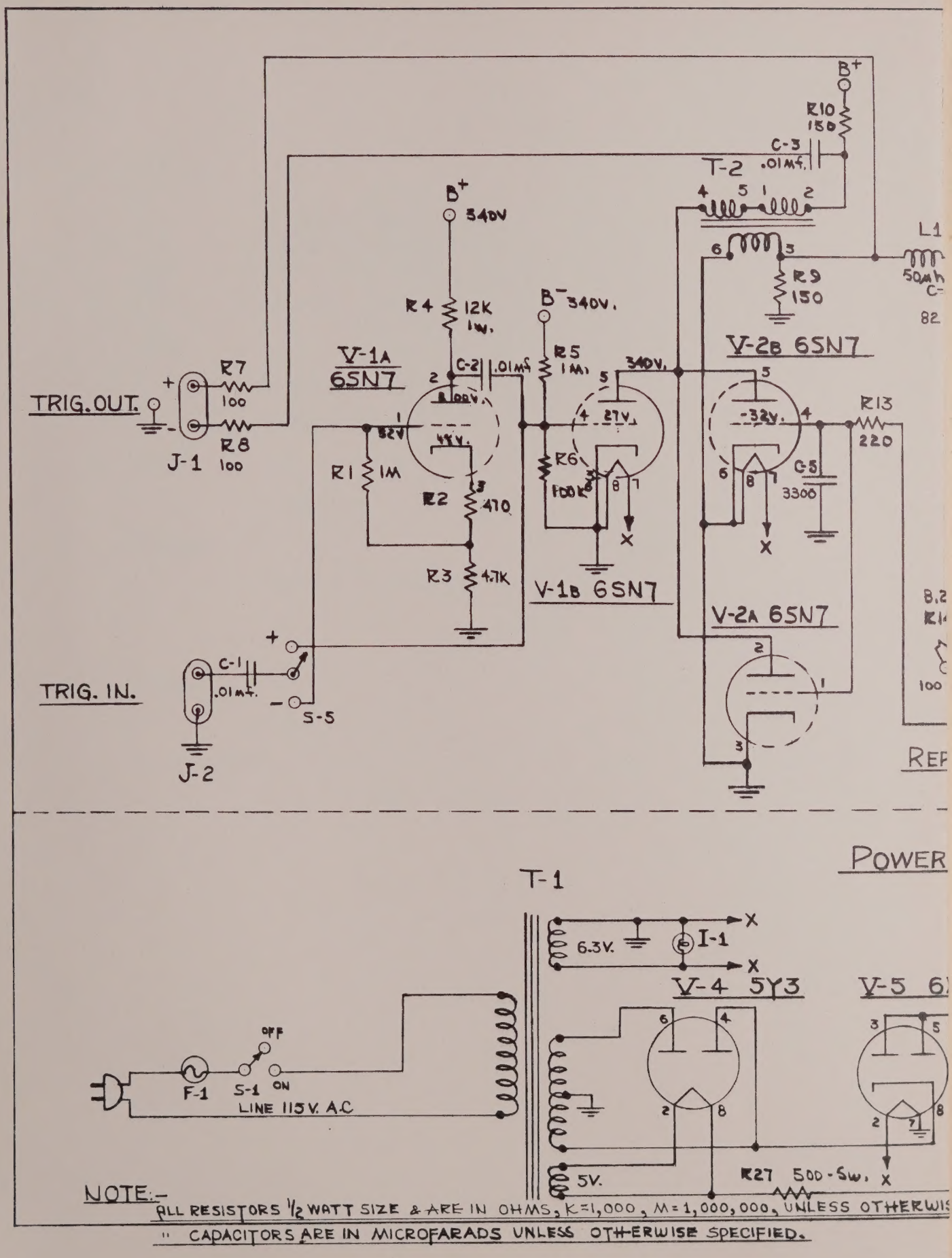
| | |
|---|---|
| #1 | Special Co-axial RG/59/U - 75 ft. |
| #2 | " " " - 30 ft. |
| #3 | " " " - 14 ft. |
| #4 | " " " - 5 ft. |

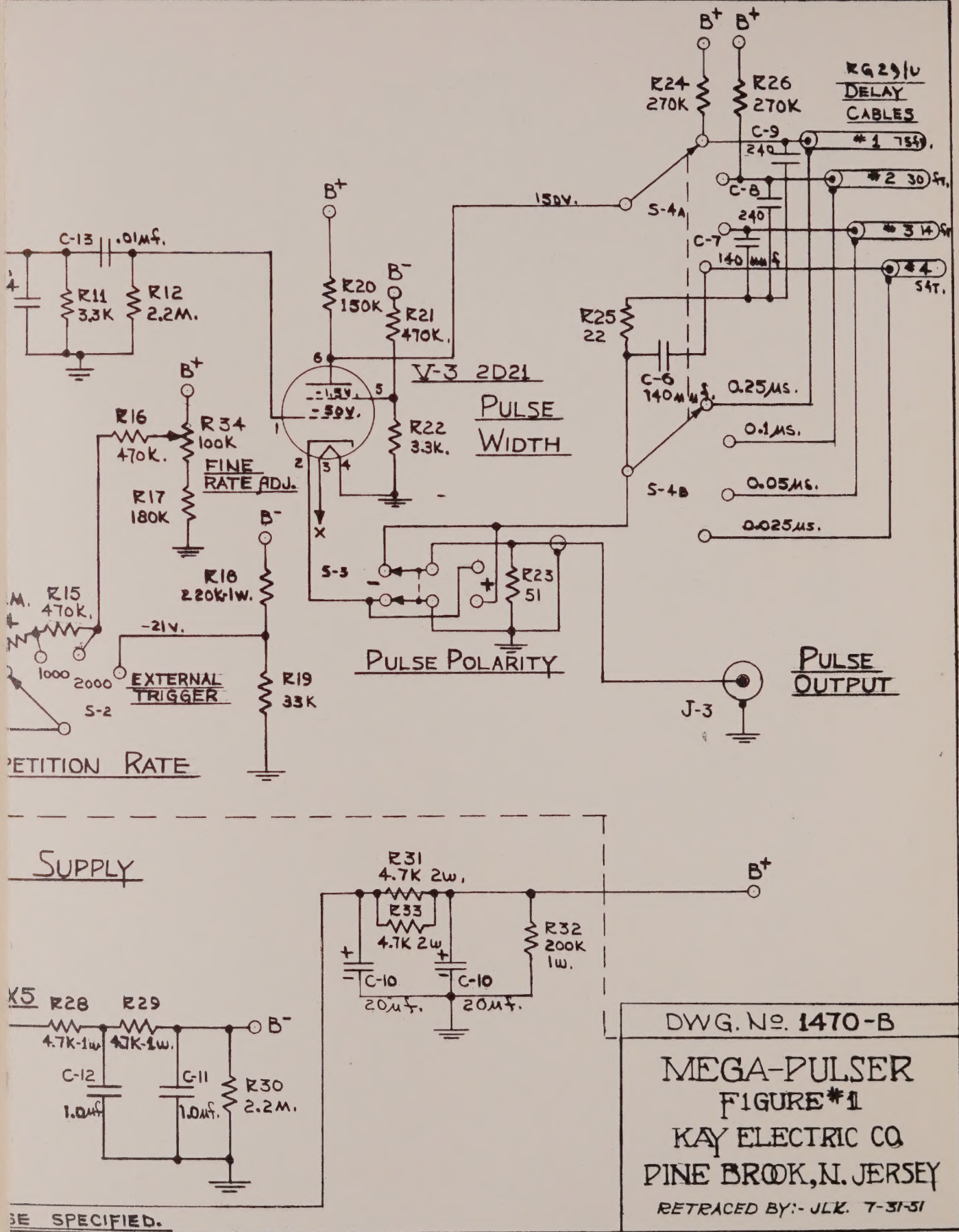
### FUSES:

| | |
|---|---|
| F-1 | 3 amp. |

### PILOT LAMPS:

| | | |
|---|---|---|
| I-1 | 6-8 V. | GE#44 - #47 Bayonet type |


B+
R10 150
C-3 .01 Mf.
T-2
B+ 340V
R4 12K 1W.
B- 340V.
L1 50 mh
R9 150
V-1A 6SN7
C-2 .01 Mf
R5 1 M.
340V.
V-2B 6SN7
TRIG. OUT.
R7 100
R8 100
J-1
R1 1M
R2 470
R3 4.7K
R6 100K
R13 220
C-5 3300
-32V.
V-1B 6SN7
V-2A 6SN7
TRIG. IN.
C-1 .01 Mf.
S-5
J-2
POWER
T-1
6.3V.
I-1
V-4 5Y3
V-5 6
OFF
ON
F-1
S-1
LINE 115 V. A.C
5V.
R27 500 - 5w.
X
NOTE:-
ALL RESISTORS 1/2 WATT SIZE & ARE IN OHMS, K=1,000, M=1,000,000, UNLESS OTHERWIS
" CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.




DWG. No. 1470-B

# MEGA-PULSER

FIGURE #1

KAY ELECTRIC CO.

PINE BROOK, N. JERSEY

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